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AESTRACT

Reminiscence, or an increase in retention scores from a short-to-long-term retention test, has been shown in some previous work to be a significant function of arousal. Previous studies of the effects of color versus black-and-white audiovisual presentations have generally used film or television and have found no facilitating effect of color on learning or achievement. No such studies, however, have specifically studied reminiscence, although there is reason to believe that color would be more arousing than black-and-white and thus should facilitate reminiscence. The present experiment examined reminiscence over one week as a function of color versus black-and-white slide-tape presentations. It was found that the proportion of subjects reminiscing in the color condition was significantly greater (p.05, one-tailed test) than the proportion reminiscing in the black-and-white condition. No contribution of a measure of individual differences in arousal or stimulation seeking was obtained. The relative lack of strength of the color effect was noted, and some design considerations for further research on learning and memory effects of color were outlined. (Author/MC)

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AROUSAL AND REMINISCENCE IN LEARNING FROM COLOR AND BLACK/WHITE AUDIO-VISUAL PRESENTATIONS

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The literature on the effect on learning of color as opposed to black and white presentations in film and television has generally indicated no significant learning differences, except where the use of color is essential to the content being communicated, for example, as in a presentation on the color spectrum. Most of the studies in this area have considered either movie film or television presentations. Very little research has been concerned with slide-tape presentations.

Although learning does not generally seem to be influenced by color over black/white presentation, there is reason to believe that color should influence memorial processes in learning from such media. Considerable evidence is available that long-term retention is a significant function of physiological arousal during learning (2), with high arousal leading to better retention than low arousal. Reminiscence, or increase in retention over time, as opposed to forgetting over time, is usually significantly greater following high-over low-arousal learning. It may be hypothesized that color is more physiologically arousing than black and white although systematic physiological data to support this hypothesis are not available. Wilson (7) has reported that the warm color red is physiologically more arousing than the cool color green. Many studies have demonstrated

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that black and white are ranked where apparent temperature is concerned nearer to green and blue than to such hot colors are red, orange and yellow (6). From the foregoing analysis it would be predicted that color presentations would lead to a greater incidence of reminiscence relative to black/white presentations. One problem where this hypothesis is concerned is that the bulk of prior research on color versus black/white presentation has not employed long-term retention tests as well as short-term tests. Without such a repeated measures design it is not possible to estimate the differential incidence of reminiscence between the two presentation conditions. It is possible that although as the literature has shown, color versus black/white presentation do not usually lead to initial learning differences, there may be reminiscence differences between the two presentations. More relevant studies have been of the one-test-session type. Performance is assessed following the film or television presentation. However, in few cases is a long-term retest given. Thus, although initial differences may be negligible, the incidence of long-term reminiscence, or at least resistance to forgetting, may be greater following color over black/white presentation.

An additional factor relevant to the general finding of no color versus black-white differences in learning may lie in the consideration of individual differences. It is possible that although generally no main effect of color were obtained, color presentations were better for some than other subjects, as were black-white presentations. From the present theoretical perspective, a relevant individual

difference variable is that of intrinsic arousal (2) or excitement-seeking. A personality dimension that has recently been given considerable importance in the discussion of personality is that of stimulation- or excitement-seeking (3). Persons differ reliably in the degree to which they seek stimulation, presumably because they differ in their underlying arousal levels. Those persons who are low in intrinsic physiological arousal will seek stimulation to raise their arousal to levels more optimal for effective functioning, relative to those persons who are high in intrinsic physiological arousal who will avoid or not seek stimulation so as to lower their arousal to levels more optimal for effective functioning. This theoretical relationship of arousal to stimulation-seeking assumes an inverted-U shaped relationship of arousal level to effective psychological functioning. Evidence for such a relationship has been presented by Berlyne (1), Farley (2), and Leuba (4) among others. On the basis of the present theoretical analysis, the greatest incidence of reminiscence or at least resistance to forgetting would be expected in high arousal persons (low stimulation-seeking) when color presentation is used. Least reminiscence or least resistance to forgetting would be expected in low arousal persons (high stimulation-seeking) when black/white presentation is used.

The present study was undertaken to test our hypothesis relating reminiscence to color versus black/white presentation and individual differences in arousal using a slide-tape presentation.

METHOD Subjects consisted of 52 nursing students in training at the University of Wisconsin in 1970. These students comprised most of the beginning nursing students taking a required short course in an audio-tutorial laboratory. This laboratory prepared students to effectively employ various equipment and procedures in studying subject matter areas. Prior to taking the course, they were shown a 20-slide overview, at a 15 second presentation rate, of the laboratory and its functions and characteristics. The subjects were presented the slide-tape program at the same time, with one-half randomly assigned to a color presentation and one-half to a black/white presentation, with the two different presentations occurring simultaneously in two comparable rooms. The arrangement of the equipment (e.g. size of image on screen, etc.) was identical between the two conditions. A 20-item multiple-choice (4 choice) comprehension test consisting of 10 literal and 10 inferential items was given immediately following the first presentation of the material. There was one item in the test for each slide presented. Order of items on the test was random. One week later this test was again given to each subject. The subjects were unaware that they were to be tested, either for the immediate test or the long-term test. Responding was anonymous. In addition to the slide-tape presentation, all subjects were administered a background questionnaire (e.g. age, GPA, parental occupations, etc.) and the Sensation-Seeking Scale (SSS) of Zuckerman, Kolin, Price and Zoob (8). This 22-item scale has been widely used as a measure of individual differences in stimulation-

seeking and has relatively high reliabilities and construct validity (3).

RESULTS The first data analysis considered the main effect of color on the incidence of reminiscence. Reminiscence was defined as an increase in retention test performance of one item or more from the short-term to the long-term retention test. The number of subjects who demonstrated reminiscence were: color condition = 10, black/white condition = 6. The number of subjects who demonstrated forgetting (a decrease in retention test performance of one item or more from the short-term to the long-term retention test) were: color condition = 8, black/white condition = 12. The proportion of people who reminisced in the color and black/white conditions was compared by Fisher's z test of independent proportions. This difference was found to be in line with prediction and significant at $p < .05$ (one-tailed test). It should be noted that persons who neither reminisced or decreased in retention score over time were not included in this analysis. Although obviously not statistically significant, the mean performance scores on the short-term test of both the reminiscence and forgetting groups under the color condition were very slightly higher than under the black/white condition, this mean difference being approximately one test item for the "forget" subjects and less than one-half a test item for the "reminisce" subjects.

The individual differences analysis was accomplished by taking the subjects included in the analysis above and separately within the color condition and again within the black/white condition putting

them into two groups by a median split on the Sensation-Seeking Scale. No statistical analysis was performed on these data as it was found that the frequency of "reminiscing" subjects was the same in the high and low SSS groups in the color condition, and also was the same in the high and low SSS groups in the black/white condition. No concentration of reminiscing subjects in any particular SSS group was found.

DISCUSSION

The present results are in contrast to much prior research in demonstrating significant effects of color on memory for audio-visual material. The primary differences between the present and prior research seem to lie in the present focus on reminiscence analyses and in the use of slide-tape as opposed to film or television presentation. The concern for long-term retention effect and the phenomenon of reminiscence lay in the theoretical orientation based on an arousal analysis of memory. The present results extend the work on arousal and retention from list learning (2) and film (5) to slide-tape, and are generally in line with previous results, although previous studies did not use color as a putative arousal agent. However, the relatively weak effect ($p < .05$, one-tailed test) of color effects on reminiscence are needed, using other materials, subjects, and procedural characteristics. The importance of including long-term retention tests is underscored. Also included in such studies should be ongoing real-time measurement of psychological arousal effects of color. A notion that arousal facilitates memory storage or transfer from short- to long-term storage with consequent reminiscence or superior long-term retention (2) seems

supported by these results. However, the best theoretical interpretation is not obvious, given the lack of an independent measure of arousal, the relatively weak effect observed, the circumscribed sample, and the difficulty of applying multi-stage memory process analyses to the present complex, non-laboratory, in vivo real-life learning task, considering that most recent memory stage models have dealt with relatively "simple" learning tasks such as paired-associate, serial and free-recall.

The lack of contribution to reminiscence of individual differences in stimulation-seeking or arousal may be due to the relatively small sample for such individual differences analyses, and the use of a median split on the SSS rather than a division that would yield more extreme groups. However, the latter would have yet further reduced the former, and given the zero order contribution to reminiscence of individual differences in stimulation-seeking, one would not be optimistic that more extreme groups would demonstrate a reminiscence x color x stimulation-seeking relationship. A more fruitful approach might lie in the use of extreme SSS groups, or groups identified by a physiological arousal measure (2) with animated color versus black/white presentations, that is, film or television. The static presentation of color in a slide-tape may be insufficiently arousing to "trigger" the intrinsic arousal differences of the subjects. The possible individualization of instruction by media might be served by pursuit of such an hypothesis, attempting to adapt color versus black/white film presentation to arousal characteristics of the learner.

SUMMARY Reminiscence, or an increase in retention scores from a short- to long-term retention test, has been shown in some previous work to be a significant function of arousal. Previous studies of the effects of color versus black/white audio-visual presentations have generally used film or television and have generally found no facilitating effect of color on learning or achievement. No such studies, however, have specifically studied reminiscence, although there is reason to believe that color would be more arousing than black/white and thus should facilitate reminiscence. The present experiment examined reminiscence over one week as a function of color versus black/white slide-tape presentations. It was found that the proportion of subjects reminiscing in the color condition was significantly greater ($p < .05$, one-tailed test) than the proportion reminiscing in the black/white condition. No contribution of a measure of individual differences in arousal or stimulation-seeking was obtained. The relative lack of strength of the color effect was noted, and some design considerations for further research on the learning and memory effects of color were outlined. Theoretical discussion considered arousal and memory storage processes.

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FOOTNOTES

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